REMARKS/ARGUMENTS

This response is timely filed as it is filed within the three (3) month shortened statutory period for response to the outstanding Office Action.

Claims 1-28 remain in the application.

As a preliminary matter, the undersigned wishes to thank Examiner Spisich for the many courtesies extended during the above-identified telephonic interview.

SUMMARY OF EXAMINER INTERVIEW

Matters discussed in the referenced interview included: the rejection of certain of the claims (e.g., claim 1) as being unpatentable over U.S. Patent 5,970,880 to Perotto (hereinafter "Perotto") in view of U.S. Patent 6,139,055 to Dahl et al. (hereinafter "Dahl") and further in view of U.S. Patent 6,598,901 to Nakashima et al. (hereinafter "Nakashima"). More particularly, the throttling or flow control arrangement or scheme provided by the claimed inflator device both during single stage and dual stage combustions, respectively, as well as the claimed required inclusion of a supply of first gas-generating pyrotechnic material having a burn rate that is pressure dependent within the first combustion chamber were discussed in view of Perotto in combination with the secondary references, Dahl and Nakashima.

Arguments, as elaborated in greater detail below, were presented in an effort to more clearly distinguish the presently claimed invention from the cited prior art references and combinations thereof. In addition, the possibility of certain amendments to the claims, particularly amendments to claim 1, were also discussed in an effort to more clearly differentiate the claimed invention over the prior art. No agreement was reached with regard to the amendment or patentability of the pending claims. The interview, however, is believed to have led to a better understanding of how the references are being applied against the claimed invention, with this written response in support of the patentability of the pending claims being an end result.

Request for Telephone Interview

If after consideration of the remarks and arguments herein presented the patent application is not deemed to be in condition for allowance, the undersigned hereby expressly requests a telephone interview with the Examiner to discuss the merits of this patent application. To that end, if the Examiner feels the claims are not allowable for any reason, the Examiner is requested to telephone the undersigned, Nick C. Kottis, at (847) 490-1400, to resolve any outstanding matter.

Claim Rejections - 35 U.S.C. §103

Claims 1-28 were rejected under 35 U.S.C. §103(a) as being unpatentable over Perotto in view of Dahl in further view of Nakashima.

The Action alleges that it "would have been obvious to one of ordinary skill in the art at the time the invention was made to use materials having the characteristics as claimed in the dual stage inflator as disclosed by Perotto, since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice." The Action further alleges that Nakashima discloses that "it is known in the art to vary the materials as previously discussed to optimize the operating characteristics of the inflator."

Such rejections are respectfully traversed.

As detailed in the application, adaptive inflation systems such as in the form of a dual-stage inflator are known in the art. (See page 4, line 16 through page 5, line 20, for example.) The prior art, however, generally fails to provide an adaptive inflator device and associated combinations having as simple and as effective a design and operation as may be desired. In particular, the prior art generally fails to provide such adaptive inflator devices and associated combinations such as may provide or

result in a long burning and low mass flow combustion such as may be desired in response to a low speed crash incident or in event of an out-of-position occupant, and a relatively short burning and increased or high mass flow combustion such as may be desired in response to a high speed crash incident, for example. (See page 11, lines 1-8, for example.)

The invention desirably provides an improved adaptive inflator device wherein during a single stage combustion a controlling orifice formed in a combustion chamber throttles a gas-generating pyrotechnic material reaction to produce a single stage combustion product gas, and during a dual stage combustion a plurality of diffuser orifices formed in a diffuser chamber throttles the gas-generating pyrotechnic material reaction to produce a dual stage combustion product gas. (See page 8, lines 4-10, for example.)

As set forth at page 8, line 13 through page 10, line 2:

In accordance with a preferred embodiment, there is provided an inflator device which includes a diffuser chamber and a first combustion chamber connected to the diffuser chamber. A supply of a first gas-generating pyrotechnic material having a burn rate that is pressure dependent is contained within the first combustion chamber and, wherein at least a portion of the supply of the first gas-generating pyrotechnic material is reactable. The gas-generating pyrotechnic material has a burn rate pressure dependency of at least about 0.55, where the burn rate pressure dependency is represented by n in a burn rate expression:

$$r_b = k(P)^n$$

where r_b is the burn rate of the first gas-generating pyrotechnic material, k is a constant, P is pressure, and n is a slope of a linear regression line drawn through a log-log plot of burn rate versus pressure. The first combustion chamber forms a controlling orifice. This controlling orifice provides independent fluidic communication between the first combustion chamber and the diffuser chamber. This controlling orifice serves to throttle a single stage combustion wherein the supply of the first gas-generating pyrotechnic material is selectively reactable to produce a first combustion chamber single stage combustion product gas.

The inflator device also includes a second combustion chamber connected to the diffuser chamber. A supply of a second gas-generating pyrotechnic material is contained within the second combustion chamber and, wherein at least a portion of the supply of the second gas-generating pyrotechnic material is reactable. A controlling orifice formed by the second combustion chamber provides independent fluidic communication between the second combustion chamber and the diffuser chamber. This controlling orifice throttles a single stage combustion wherein the supply of the second gas-generating pyrotechnic material is selectively reactable to produce a second combustion chamber single stage combustion product gas.

A plurality of diffuser orifices are formed in the diffuser chamber. The diffuser orifices throttle a dual stage combustion wherein the supply of the first gas-generating pyrotechnic material is reactable to produce a first combustion chamber dual stage combustion product gas and the supply of the second gas-generating pyrotechnic material is reactable to produce a second combustion chamber dual stage combustion product gas.

With operation of only one of the first or the second combustion chambers, the inflation fluid flow can be too low or insufficient for the orifice area of the diffuser to serve as a controlling orifice or otherwise choke the inflation gas flow therethrough. However, with both the first and the second combustion chambers operating, the combined inflation fluid flow is sufficiently great as to overwhelm the diffuser exit area (e.g., the diffuser orifices). As a result, the flow choke point or

throttling orifice area is effectively moved or relocated from the exit areas or orifices of each of the combustion chambers, respectively, to the diffuser exit area (e.g., the diffuser orifices) and such that the net operating pressure within the inflator device is controllably increased. As will be appreciated by those skilled in the art and guided by the teachings of the subject application, varying effects are attainable by employing a gas generant having a high burn rate pressure dependency in either or both chambers of an inflator device in accordance with the invention. For example, in accordance with certain preferred embodiments of the invention and when using a gas generant having a high burn rate pressure dependency, the benefits resulting from such operation may desirably include a longer burn time or duration for a single chamber combustion operation and a shorter burn time or duration for a dual chamber combustion operation. (See page 10, lines 3-21, for example.)

It is respectfully submitted that there has been no prior art showing or suggestion of an inflator device wherein a controlling orifice formed by a first combustion chamber controls or throttles a single stage combustion of the supply of the pyrotechnic material contained within the first combustion chamber; a controlling orifice formed by a second combustion chamber controls or throttles a single stage combustion of the supply of the pyrotechnic material contained within the second combustion chamber; and wherein a plurality of diffuser orifices formed the diffuser

chamber of the inflator device control or throttle dual stage combustion wherein the both supply of the first gas-generating pyrotechnic material and the second gas-generating pyrotechnic material are reactable to produce respective a first and second combustion chamber dual stage combustion product gas, as required by the claimed invention.

In particular, there has been no prior art showing or suggestion of a multi-combustion chamber inflator device which utilizes certain openings or orifices to throttle or control combustions of a single chamber or stage and other openings or orifices to throttle or control multi-chamber combustions, as in the claimed invention.

Moreover, the criticality of the value of the burn rate pressure exponent of pyrotechnic materials used in the practice of the invention are well set out in the application. In this regard, reference is made to page 17, line 10 through page 18, line 5:

> While the invention may, if desired, be practiced employing various gas generant materials, such as are known in the art, the invention has particular perceived utility when used in conjunction with those gas generant materials, e.g., pyrotechnics, which have or exhibit a relatively high burn rate pressure dependency, e.g., have a burn rate pressure exponent of 0.55 or greater, and, in accordance with certain preferred embodiments, have a burn rate pressure exponent of at least about 0.65 and, in accordance with certain preferred embodiments, have a burn rate pressure exponent more preferably within a range of about 0.65 to about 0.70. In certain preferred embodiments of the invention, it is generally desirable to avoid the utilization of a gas generating pyrotechnic material having a burn rate pressure exponent greater than

> about 0.70. In particular, gas generating pyrotechnic materials having a burn rate pressure exponent greater than about 0.70 may exhibit so great a sensitivity to pressure that inflator performance of sufficient reliability may not be practically attainable. Such highly pressure sensitive gas-generating pyrotechnic material can be represented by a linear regression line having a large slope drawn through a log-log plot of burn rate versus pressure.

It is respectfully submitted that such inflator devices and combinations are neither shown nor suggested by Perotto, Dahl and/or Nakashima, alone or in combination.

As required by the claims and discussed in the specification, during a single stage combustion, a controlling orifice formed in the first combustion chamber throttles the single stage combustion to produce a first combustion chamber single stage combustion product gas. During a second stage combustion, however, each of the first supply of gas-generating pyrotechnic material and a second supply of gas-generating pyrotechnic material is reacted to produce a first combustion chamber dual stage product gas and a second combustion chamber dual stage combustion gas, respectively. The combined inflation fluid flow is sufficiently great such that the flow choke point or throttling orifice area is effectively relocated from the exit areas or orifices of each of the combustion chambers, respectively, to the diffuser exit area (e.g., the diffuser orifices) and such that the net operating pressure within the inflator device is controllably increased. (See page 10, lines 3-21 and page 26, lines 3-14.)

Further, as described in the application (see page 26, lines 3-14 of the specification, for example) relative to the inflator device 10 shown in FIG. 1, the internal combustion pressure within the inflator device 10, and hence within the first combustion chamber 30 increases, the burn rate of the supply of the first gas-generating pyrotechnic material 40 increases due to the increased internal combustion pressure and the first gas-generating pyrotechnic material high burn rate pressure exponent, e.g., a burn rate pressure dependency of at least about 0.55, as required by each of independent claims 1, 19 and 28, respectively.

In this regard, it is noted that the Action acknowledges that:

> Perotto **does not disclose** the particular characteristics of the pyrotechnic materials and inflator. (Emphasis added.)

It is respectfully submitted that neither does Perotto show or suggest the incorporation and use of a gas-generating pyrotechnic material having a burn rate pressure dependency of at least about 0.55, as expressly required by independent claims 1, 19 and 28.

Such shortcomings of Perotto relative to the claimed invention are not overcome by the proposed combination of either or both Dahl and/or Nakashima therewith.

The Action cites Dahl as teaching a time delay of 30 msec and also that when both igniter assemblies are used in succession, then pressure increases more

rapidly than when one chamber is used alone. The Action then proceeds to assert that "[g]iven this, and the standard burn rate expression, it is determined that the burn rates of a material are effected by the actuation of plural chambers."

Such disclosures or teachings, even if assumed true and accurate solely for the sake of argument, in no way overcome or resolve the above-identified shortcomings of Perotto relative to the claimed invention. For example, such disclosures or teachings of a time delay of 30 msec and also that when both igniter assemblies are used in succession, then pressure increases more rapidly than when one chamber is used alone, in no way shows or suggest the claimed relocation of the controlling or throttling orifice flow through area from the exit areas or orifices of each of the combustion chambers, respectively, to the diffuser exit area (e.g., the diffuser orifices), as required in the claimed invention and such that the net operating pressure within the inflator device is controllably increased. Neither do such disclosures or teachings show or suggest the incorporation and use of a gas-generating pyrotechnic material having a burn rate pressure dependency of at least about 0.55, as required in the claimed invention.

The Action cites Nakashima as teaching that it is known to adjust the actuation performance of a gas generator and that the adjustment of a two combustion chamber inflator "can be made by using gas generating agents that are different in

burn rate, composition, composition ratio, amount of each other and furthermore, a dual chamber inflator having a first stage where one chamber fires alone if desired, and dual stages where the chambers fire in unison, or in succession either one before the other."

With regard to such disclosures or teachings, even if assumed true and accurate solely for the sake of argument, in no way overcome or resolve the above-identified shortcomings of Perotto relative to the claimed invention. For example, such disclosures or teachings in no way show or suggest the claimed relocation of the controlling or throttling orifice flow through area from the exit areas or orifices of each of the combustion chambers, respectively, to the diffuser exit area (e.g., the diffuser orifices), as required in the claimed invention. Neither do such disclosures or teachings show or suggest the incorporation and use of a gas-generating pyrotechnic material having a burn rate pressure dependency of at least about 0.55, as required in the claimed invention.

In addition, at least certain of the dependent claims include additional limitations such as relating to burn duration, inflating flow rate, internal combustion chamber pressures and pyrotechnic material burn rate pressure dependency which are believed to render such claims further patentable over the prior art of record.

For example, Claim 2 additionally requires that during the single stage combustion of said supply of the first gas-generating pyrotechnic material, said supply of the first gas-generating pyrotechnic material having a burn duration of at least about 60 msec.

Claim 3 additionally requires that during the dual stage combustion of said supply of the first gas-generating pyrotechnic material, said supply of the first gas-generating pyrotechnic material having a burn duration of less than about 60 msec.

Claim 10 additionally requires that during the single stage combustion the first gas-generating pyrotechnic material has a maximum inflating flow rate of at least about 30 kmol-K/sec.

Claim 12 additionally requires that during the single stage combustion the second gas-generating pyrotechnic material has a maximum inflating flow rate of at least about 44 kmol-K/sec.

Claim 14 additionally requires that during the dual stage combustion the first gas-generating pyrotechnic material and the second gas-generating pyrotechnic material have a combined maximum inflating flow rate of at least about 90 kmol-K/sec.

Claim 15 requires that during the dual stage combustion an internal pressure of at least about 2500 psi is developed within each of said first combustion chamber and said second combustion chamber.

Claim 26 requires that during the single stage combustion an internal combustion pressure formed within one of said first combustion chamber and said second combustion chamber is not greater than about 2000 psi.

Claim 27 requires that during the dual stage combustion an internal combustion pressure developed within said first combustion chamber and said second combustion chamber is greater than about 2500 psi.

Claim 16 requires that the first gas-generating pyrotechnic material have a burn rate pressure dependency of at least about 0.65.

Claim 17 requires that the first gas-generating pyrotechnic material have a burn rate pressure dependency within a range of about 0.65 to about 0.70.

Claim 21 requires that at least one of the first gas-generating pyrotechnic material and the second gas-generating pyrotechnic material have a burn rate pressure dependency of at least about 0.65.

Claim 22 requires that at least one of the first gas-generating pyrotechnic material and the second gas-generating pyrotechnic material having a burn rate pressure dependency of about 0.65 to about 0.70.

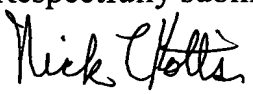
Claims 18 and 20 include limitations with regard to the burn rate pressure dependency of the second gas generating material

Such specifically claimed inflator devices and combinations are not shown or suggested by the prior art of record. More particularly, inflator devices which provide or result in such burn durations, inflating flow rates, internal combustion chamber pressures and pyrotechnic material burn rate pressure dependencies are not shown or suggested by the prior art of record and thus these claims are believed to be further patentable over the prior art of record.

Conclusion

In view of the above, all pending claims are believed to be in condition for allowance and notification to that effect is solicited. However, should the Examiner detect any remaining issue or have any question, the Examiner is kindly requested to contact the undersigned, preferably by telephone, in an effort to expedite examination of the application.

Respectfully submitted,



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